WHAT IS CLAIMED IS:

1. An exposure method performed by an exposure apparatus which has an optical system to transfer a pattern illuminated with exposure light from a light source onto a substrate, said method comprising:

setting an exposure amount control target value in accordance with a transmittance of said optical system; and

transferring said pattern onto said substrate through said optical system while an exposure amount is controlled based on said set exposure amount control target value.

2. An exposure method according to Claim 1, wherein when said exposure amount control target value is set said transmittance of said optical system is a base to set said exposure amount control target value, said transmittance being actually measured at a predetermined measurement interval.

3. An exposure method according to Claim 2, wherein said measurement interval is set in accordance with an exposure condition.

4. An exposure method according to Claim 3, wherein said exposure condition includes a transmittance of a mask.

5. An exposure method according to Claim 3, wherein said exposure condition includes one of a minimum line width

and a permissible exposure amount error.

6. An exposure method according to Claim 2, wherein said measurement interval is changed in accordance with a variation amount between a transmittance obtained by a most recent transmittance measurement and a transmittance obtained by a measurement performed before said most recent measurement.

7. An exposure method according to Claim 1, wherein said setting said exposure amount control target value includes

a prediction function determining to determine a transmittance time-varying prediction function for said optical system in accordance with an irradiation history of exposure light on said optical system, and

setting said exposure amount control target value based on said determined transmittance time-varying prediction function.

8. An exposure method according to Claim 7, wherein said time-varying function is a function expressed by

$$T = a \cdot \exp\left(\sum_{i=1}^{k} b_i t \right)$$

in which T is said transmittance of said optical system, a is a parameter representing a rate of change in said transmittance, and b_i is a parameter dependent on each exposure condition including an illumination condition.

9. An exposure method according to Claim 7, further comprising prior to said prediction function determining:

measuring a period of time in which said exposure apparatus most recently stops operation;

measuring an irradiation time of exposure light on said optical system in a self-cleaning operation which is performed after said exposure apparatus most recently stops operation;

measuring an exposure light intensity; and

measuring an irradiation amount.

10. An exposure method according to Claim 7, wherein environmental conditions for said optical system is measured at a predetermined time interval, and said environmental conditions are considered when transmittance time-varying prediction function is determined.

11. An exposure method according to Claim 7, further comprising:

measuring a transmittance of said optical system at a predetermined interval, and

corrects said transmittance time-varying prediction function each time a transmittance measurement is performed.

12. An exposure method according to Claim 11, wherein said predetermined interval of said measuring said transmittance is determined in respect to a relationship with

a required exposure precision.

13. An exposure method according to Claim 11, wherein said interval of said measuring said transmittance is

short when a rate of change in said transmittance of said optical system is large, and

long when said rate of change in said transmittance of said optical system is small.

14. An exposure method to transfer a pattern illuminated with exposure light from a light source onto a substrate through an optical system, said method comprising:

setting measurement intervals in accordance with an exposure condition; and

measuring a variation in the amount of said exposure light passing through said optical system in said set measurement intervals.

15. An exposure method according to Claim 14, wherein said exposure condition includes at least one of an illumination condition to illuminate a mask, a transmittance of said mask, a minimum line width, and a permissible exposure amount error.

16. An exposure method to transfer a pattern illuminated with exposure light from a light source onto a substrate through an optical system, said method comprising:

measuring a variation in the amount of said exposure

light passing through said optical system in a predetermined measurement interval; and

changing said predetermined measurement intervals upon said measuring, in accordance with a comparison result of a variation of a first measurement of said light amount and a variation of a second measurement of said light amount.

17. An exposure method according to Claim 16, wherein said first and second measurements are performed prior to starting of exposure.

18. An exposure method according to Claim 16, wherein said first and second measurements are performed after starting of exposure.

19. An exposure method performed by an exposure apparatus to transfer a pattern illuminated from a light source with exposure light through an optical system onto a substrate, said method comprising:

a self-cleaning to clean said optical system by irradiating said optical system with said exposure light on a predetermined condition prior to exposure;

a prediction function determining to determine a transmittance time-varying prediction function of said optical system in consideration of said predetermined condition; and

setting said exposure amount control target value based on said determined transmittance time-varying prediction

function.

20. An exposure method according to Claim 19, wherein said prediction function determining takes into consideration a period of time in which the operation of said apparatus is stopped.

21. An exposure method according to Claim 19, wherein said predetermined condition includes an irradiation time of said exposure light on said optical system, said exposure light intensity, and an irradiation amount.

22. An exposure method to transfer a pattern illuminated from a light source with exposure light through an optical system onto a substrate, said method comprising:

setting a measurement interval in accordance with an exposure condition; and

measuring an amount of said exposure light passing through said optical system in said measurement interval.

23. An exposure method according to Claim 22, further comprising:

obtaining a transmittance of said optical system in accordance with an amount of said exposure light which is measured before passing through said optical system, and said measurement result of said exposure light passing through said optical system.

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24. An exposure apparatus to transfer a pattern illuminated with exposure light from a light source onto a substrate through an optical system, said exposure apparatus comprising:

an exposure amount setting unit to set an exposure amount control target value in accordance with a transmittance of said optical system; and

an exposure amount control system connected with said exposure amount setting unit to control an exposure amount based on said set exposure amount control target value.

25. An exposure apparatus according to Claim 24, further comprising:

a transmittance measurement unit which measures a transmittance of said optical system, and

said exposure amount setting unit sets said exposure amount control target value in accordance with said transmittance measured by said transmittance measurement unit.

26. An exposure apparatus according to Claim 25, wherein said transmittance measurement unit performs said transmittance measurement at a predetermined measurement interval.

27. An exposure apparatus according to Claim 26, further comprising:

a control unit to set said measurement interval of said

transmittance measurement unit in accordance with an exposure condition.

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28. An exposure apparatus according to Claim 27, further comprising:

an information reading unit to read information of a mask on which the pattern is formed, and

said control unit automatically determines measurement intervals for said transmittance measurement unit based on said information of said mask read by said information reading unit.

29. An exposure apparatus according to Claim 26, further comprising:

a control unit connected with said transmittance measurement unit to set said transmittance measurement interval of said transmittance measurement unit in accordance with a variation amount between a transmittance obtained by a most recent transmittance measurement and a transmittance obtained by a measurement performed before said most recent measurement, said respective measurement performed by said transmittance measurement unit.

30. An exposure apparatus according to Claim 29, wherein two sequential measurements of transmittance by said transmittance measurement unit are performed prior to starting of exposure.

31. An exposure apparatus according to Claim 29, wherein two sequential measurements of transmittance by said transmittance measurement unit are performed after starting of exposure.

SUB A7 32. An exposure apparatus according to Claim 25, wherein said transmittance measurement unit includes

a first optical sensor disposed in a light path of said exposure light to detect said amount of exposure light irradiated on said pattern,

a second optical sensor arranged to be substantially flush with the substrate, and

a control unit connected with said first optical sensor and said second optical sensor to detect said amount of exposure light passing through said optical system by using said second optical sensor at a timing which corresponds to an exposure condition, and to obtain a transmittance of said optical system based on said amount of exposure light and an output from said first optical sensor.

33. An exposure apparatus according to Claim 32, wherein said exposure amount control system controls said exposure amount based on said exposure amount control target value and said output from said first optical sensor when transferring said pattern onto said substrate.

SUB A8 34. An exposure apparatus according to Claim 32, wherein said control unit detects said amount of exposure light

having passed through said optical system at a timing which corresponds to a transmittance of said mask on which said pattern is formed.

35. An exposure apparatus according to Claim 32, wherein said control unit detects said amount of exposure light having passed through said optical system at a timing set in consideration of one of a minimum line width and a permissible exposure amount error.

36. An exposure apparatus according to Claim 24, further comprising:

a first optical sensor disposed in said light path of said exposure light to detect said amount of exposure light illuminated on said pattern, and

said exposure amount control system controls said exposure amount based on said exposure amount control target value and an output from said first optical sensor when transferring said pattern onto said substrate.

37. An exposure apparatus according to Claim 24, further comprising:

a calculation unit to determine a transmittance time-varying prediction function of said optical system in accordance with an irradiation history of exposure light on said optical system, and

said exposure amount setting unit sets said exposure amount control target value based on said transmittance

time-varying prediction function determined by said calculation unit.

38. An exposure apparatus according to Claim 37, further comprising:

a transmittance measurement unit to measure said transmittance of said optical system at a predetermined interval; and

a correction unit connected with said calculation unit to correct said transmittance time-varying prediction function each time said transmittance measurement is performed.

39. An exposure apparatus according to Claim 38, further comprising:

a control unit connected with said transmittance measurement unit to set said transmittance measurement interval of said transmittance measurement unit in accordance with a variation amount between a transmittance obtained by a most recent transmittance measurement and a transmittance obtained by a measurement performed before said most recent measurement, ~~said~~ measurement performed by said transmittance measurement unit.

40. An exposure apparatus according to Claim 24, further comprising:

a mask stage disposed between said illumination optical system and said projection optical system to hold said mask

on which said pattern is formed; and

a substrate stage disposed in an image plane side of said projection optical system to hold said substrate, wherein said optical system includes

an illumination optical system disposed in an optical path of said exposure light to illuminate said mask on which said pattern is formed with said exposure light, and

a projection optical system disposed in said optical path of said exposure light to project said exposure light which exits from said mask onto said substrate.

41. An exposure apparatus according to Claim 40, further comprising:

a driving unit connected with said mask stage and said substrate to synchronously move said mask stage and said substrate stage in a linear direction perpendicular to an optical axis of said projection optical system.

Sub A9 42. An exposure apparatus to transfer a pattern illuminated with exposure light from a light source onto a substrate through an optical system, said exposure apparatus comprising:

a measurement unit to measure a variation in an amount of exposure light passing through said optical system; and

a control unit connected with said measurement unit to change intervals of said measurement performed by said

measurement unit in accordance with an exposure condition.

43. An exposure apparatus according to Claim 42, wherein said measurement unit includes

a first optical sensor disposed in an optical path of said exposure light to detect said amount of exposure light irradiated on said pattern, and

a second optical sensor arranged to be substantially flush with said substrate.

44. An exposure apparatus to transfer a pattern illuminated with exposure light from a light source onto a substrate through an optical system, said exposure apparatus comprising:

a measurement unit to measure a variation in an amount of exposure light passing through said optical system; and

a control unit connected with said measurement unit to change an interval of a measurement performed by said measurement unit, in accordance with a comparison result of a variation of a first measurement of said light amount and a variation of a second measurement of said light amount.

45. An exposure apparatus to transfer a pattern illuminated with exposure light from a light source onto a substrate through an optical system, said exposure apparatus comprising:

a unit which communicates with said optical system to self-clean said optical system by irradiating said optical

system with said exposure light in a predetermined condition before starting of exposure;

a calculation unit connected with said unit to determine a transmittance time-varying prediction function of said optical system in consideration of said predetermined condition; and

an exposure amount setting unit connected with said calculation unit to set an exposure amount control target value based on said determined transmittance time-varying prediction function.

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46. An exposure apparatus to transfer a pattern illuminated with exposure light from a light source onto a substrate through an optical system, said exposure apparatus comprising:

a measurement unit to measure an amount of exposure light passing through said optical system at a predetermined interval; and

a control unit connected with said measurement unit to set said interval of a measurement performed by said measurement unit in accordance with an exposure condition.

47. A method of making an exposure apparatus to transfer a pattern of a mask onto a substrate, said method comprising:

providing an illumination optical system to irradiate said mask with exposure light;

providing a projection optical system to project said

exposure light emitted from said mask onto said substrate;

providing a substrate stage to hold said substrate;

providing an exposure amount setting unit to set an exposure amount control target value in accordance with a transmittance of said projection optical system; and

providing an exposure amount control system to control an exposure amount based on said exposure amount control target value.

48. A method of making an exposure apparatus according to Claim 47, further comprising:

providing a mask stage to hold said mask; and

providing a driving unit to synchronously move said mask stage and said substrate stage on respective planes parallel to a linear direction perpendicular to an optical axis of said projection optical system.

49. A device manufacturing method including a lithographic process, wherein exposure is performed in said lithographic process by using said exposure method according to Claim 1.

50. A device manufacturing method including a lithographic process, wherein exposure is performed in said lithographic process by using said exposure method according to Claim 14.

51. A device manufacturing method including a lithographic process, wherein exposure is performed in said lithographic process by using said exposure method according to Claim 16.

52. A device manufacturing method including a lithographic process, wherein exposure is performed in said lithographic process by using said exposure method according to Claim 19.

53. A device manufacturing method including a lithographic process, wherein exposure is performed in said lithographic process by using said exposure method according to Claim 22.

54. A device manufactured by using said exposure apparatus according to Claim 24.

55. A device manufactured by using said exposure apparatus according to Claim 42.

56. A device manufactured by using said exposure apparatus according to Claim 44.

57. A device manufactured by using said exposure apparatus according to Claim 45.

58. A device manufactured by using said exposure

apparatus according to Claim 46.